

Asthma Prevalence, Cost, and Adherence with Expert Guidelines on the Utilization of Health Care Services and Costs in a State Medicaid Population

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Objective. To provide a descriptive analysis of asthma prevalence and costs in a Medicaid population and gauge the degree of adherence with expert guidelines for asthma medication management from the National Asthma Education and Prevention Program.

Data Sources. Kentucky Medicaid administrative data for 1996.

Study Design. A cross-sectional retrospective analysis was used to determine adherence with asthma medication guidelines and utilization of asthma-related health care services and costs. Multivariate logistic regression was used to determine the relationship between nonadherence with the guidelines and utilization of health care services.

Principal Findings. Of the 530,000 Medicaid recipients, 24,365 (4.6 percent) were identified as having asthma. Average annual asthma-related costs (\$616) accounted for less than 20 percent of total health care costs (\$3,645). Nonadherence to the guidelines was prevalent. Less than 40 percent of the patients received a prescription for a rescue medication, and fewer than 10 percent of the patients who received daily inhaled short-acting beta-2 agonists were regular users of inhaled steroids. Nonadherence to the guidelines was associated with an increased risk of an asthma-related hospitalization (odds ratio = 1.5, $p < .05$).

Conclusions. Guideline nonadherence was widespread and associated with an increase in exacerbations of asthma that resulted in hospitalizations. Asthma prevalence and utilization of health care services in a Medicaid population were similar to previous estimates reported nationally and in health maintenance organizations.

Key Words. Medicaid, asthma, claims data, utilization of health care services

BACKGROUND

Asthma is a common chronic disease that affects an estimated 14 million Americans (Centers for Disease Control and Prevention 1998). Treatment of asthma can usually be accomplished in the outpatient setting and, when well controlled, rarely leads to hospitalization. Asthma-associated morbidity and mortality are largely preventable through improved patient education and medical management (Weiss, Gergen, and Hodgson 1992; National Heart, Lung, and Blood Institute 1997), although treatment requires continuous medical care to avoid the sequelae of acute exacerbations, such as emergency room care, hospitalization, and death (Blumenschein and Johannesson 1998).

To reduce asthma prevalence, morbidity, and mortality, the National Asthma Education and Prevention Program under the auspices of the National Heart, Lung, and Blood Institute developed expert guidelines for the diagnosis, management, and treatment of asthma (National Heart, Lung, and Blood Institute 1997). The asthma medication component of these guidelines, hereafter referred to as the "guidelines," advocate first-line use of anti-inflammatory agents, that is, inhaled steroids and mast-cell stabilizers as maintenance drugs for chronic disease control and inhaled short-acting beta-2 agonists as rescue medications for the treatment of acute exacerbations only on an "as needed" basis.

Studies have shown that adherence to the guidelines' recommendation of use of inhaled steroids was associated with a decrease in the relative risk of asthma-related hospitalizations (Donahue, Weiss, Livingston, et al. 1997), emergency room (ER) visits (Laumann and Bjornson 1998), and asthma costs (Balkrishnan, Norwood, and Anderson 1998). Other studies have found that noncompliance with the guidelines, in particular regular or overuse of short-acting beta-2 agonists, was associated with decreased asthma control (Sears, Taylor, Print, et al. 1990), increased utilization of ER and hospital services (Nestor et al. 1998), increased risk of hospitalization (Donahue,

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Weiss, Livingston, et al. 1997), and increased morbidity and costs (Stempel, Durcanin-Robbins, Hedblom, et al. 1996).

The prevalence of, utilization of health care services for, and cost of asthma have been estimated at the national level and from the perspective of commercial health maintenance organizations (HMOs) (Centers for Disease Control and Prevention 1998; Weiss, Gergen, and Hodgson 1992; Nestor et al. 1998; Smith, Malone, Lawson, et al. 1997; Stempel et al. 1996; Langley 1999). However, little data are available on the prevalence of, utilization of health care services for, and costs of asthma in state Medicaid populations. In addition, little research has investigated the degree and effects of guideline adherence among vulnerable Medicaid recipients. Medicaid populations typically contain larger numbers of minorities and other patient groups, such as the disabled and blind that are traditionally not covered by private employer-provider health insurance plans. Because the Medicaid population may have higher disease levels and lower, less continuous access to quality medical care, it represents a unique and important population to study.

The purpose of this study was to (1) provide a descriptive analysis of the demographics of, utilization of health care services for, and costs of asthma in a Medicaid program; (2) determine if patients received appropriate pharmacological therapy consistent with the guidelines; and (3) assess whether nonadherence with the guidelines was associated with increased asthma-related ER care and hospitalizations. Studying the costs and appropriateness of asthma therapy will provide insight into how current health care resources are allocated and how treatment alternatives affect costs and patient health. The analysis presented in this article can help guide future health policy and resources to create more cost-effective therapies for asthma in Medicaid populations.

METHODS

Data for this study were extracted from a database containing over 20 million paid claims for pharmacy, institutional (hospital, nursing home, mental hospital, etc.), and medical (physician, dentist, and other nonpharmacy providers) services. The database represents the entire claims history for 530,000 Kentucky Medicaid recipients during calendar year 1996. To be included in the analysis, patients were required to have at least one medical claim containing a primary diagnosis of asthma, defined by *International Classification of Diseases, Ninth Revision—Clinical Modification* (ICD-9-CM) codes 493, 493.0,

493.00, 493.01, 493.1, 493.10, 493.11, 493.9, 493.90, and 493.91 (*St. Anthony's Softbound ICD-9-CM CodeBook Volumes 1,2,3* 1997). Individuals with medical claims containing a primary diagnosis of chronic obstructive pulmonary disease (ICD-9-CM codes 496, 496.0, 496.00, 496.01, 493.2, 493.20, 493.21) or cystic fibrosis (ICD-9 codes 277, 277.0, 277.00, 277.01) were excluded from the analysis.

Estimated prevalence and rates of utilization of asthma-related health care services (outpatient and ER visits and hospitalizations) were calculated for separate gender and racial groups. All costs were the actual amount Medicaid paid to health care providers and were categorized into asthma-related and nonasthma-related pharmacy, provider, and institutional costs.

Asthma-related pharmacy costs were calculated for the following medication classes: inhaled short-acting beta-₂ agonists, other short-acting beta-₂ agonists (tablet, syrup, and nebulizer solution), ipratropium, long-acting beta-₂ agonists, oral steroids, inhaled steroids, mast-cell stabilizers, and xanthines. Leukotriene modifiers were not included in the analysis because they were not available during the study year. The costs of all other medications were considered nonasthma related. Medications in the database were identified by their generic product code sequence number (First DataBank, San Bruno, CA). A unique generic product code sequence number is assigned to all products that have the same active ingredients and dosage form, regardless of manufacturer. For example, all albuterol metered-dose inhalers have the same generic product code sequence number.

All medical and institutional claims containing a primary or secondary ICD-9-CM code for asthma were considered asthma related. All other medical and institutional claims were considered nonasthma related. Medical and institutional claims were further divided into management of the patient in the ER, inpatient, outpatient, or other setting. Encounters in which multiple claims from different providers were submitted with the same date of service and relating to the same encounter were considered a single visit for the purposes of calculating utilization rates.

Asthma management strategies differ based on disease severity. The use of inhaled short-acting beta-₂ agonists on an as needed basis is usually sufficient to control the symptoms of patients with intermittent disease. For patients with persistent asthma, regardless of disease severity, the guidelines recommend the use of daily anti-inflammatory medications to improve asthma control and subsequently reduce the risk of ER visit or hospitalization. The guidelines refer to inhaled corticosteroids as being the most potent and consistently effective long-term control medication for asthma.

According to the guidelines, all patients should have access to a rescue medication (inhaled short-acting beta₂ agonists); however, use of inhaled short-acting beta₂ agonists on a daily basis is indicative of poor asthma control and the need for long-term control therapy (National Heart, Lung, and Blood Institute 1997). Thus, nonadherence to the guidelines, that is, daily or overuse of inhaled short-acting beta₂ agonists in the absence of concurrent inhaled corticosteroid use, should be associated with an increased risk of ER visit and hospitalization.

STATISTICAL ANALYSIS

Descriptive statistics were used to determine the prevalence of, demographics of, utilization of health care services for, and costs of asthma. Multivariate logistic regression analyses were used to determine the relationships between nonadherence with the guidelines and utilization of asthma-related ER visits and hospitalizations.

Only patients who received inhaled short-acting beta₂ agonists were included in the regression models. ER visits and hospitalizations were dichotomized so that patients with one or more visits were coded 1 and patients with no visits were coded 0. In the regressions, we controlled for demographic variables, the use of other medications, and the risk factors urban residence and race, which are known to be associated with increased asthma prevalence, morbidity, and mortality (Centers for Disease Control and Prevention 1998; Wissow, Gittelsohn, Szklo, et al. 1988; Gerstman, Bosco, and Tomita 1993; Bosco, Gerstman, and Tomita 1993; Gottlieb, Beiser, and O'Connor 1995; Joseph, Havstad, Ownby, et al. 1998). All data extractions, manipulations, and statistical analyses were conducted using SAS software (SAS Institute, Inc. Cary, NC), version 6.12.

For the regression analyses we categorized individuals into one of three groups: daily users of inhaled short-acting beta₂ agonists; inhaled steroid users; and a control group that included individuals who did not receive inhaled short-acting beta₂ agonists on a daily basis or inhaled steroids. Refer to Table 1 for how each group was defined. We assumed that the "daily users" represented patients who were nonadherent with the guidelines and should be at greatest risk for an ER visit or hospitalization. Inhaled steroid users were patients with persistent asthma managed in accordance with the guidelines. The control group was thought to represent patients with intermittent asthma (do not require daily anti-inflammatory therapy) who should be at lowest risk for an acute exacerbation requiring an ER visit or hospitalization.

Table 1: Utilization of Asthma-Related Health Care Services by Patient Group

<i>Patient Group</i>	<i>Definition</i>	<i>ER Visits per 1,000</i>	<i>Hospitalizations per 1,000</i>
Daily beta-agonist users, <i>n</i> = 2,520	Patients who received greater than one canister per month of an inhaled short-acting beta- ₂ agonist and did not receive inhaled steroids on a continuous basis.	260.7	135.3
Inhaled steroid users, <i>n</i> = 320†	Patients with persistent asthma who received inhaled steroids on a continuous basis (at least eight months out of the year).	181.3	134.4
Control patients, <i>n</i> = 5,804	Patients with intermittent asthma who did not use inhaled short-acting beta- ₂ agonists on a daily basis or receive inhaled steroids on a continuous basis.	178.8	86.0

†A total of 214 received greater than one canister per month of an inhaled short-acting beta-₂ agonist.

RESULTS

The demographics and rates of utilization of health care services for the 24,365 patients identified as having asthma are presented in Table 2. The overall prevalence of asthma in the entire Medicaid population was 4.6 percent. The largest patient groups were white, children younger than 16, and females. Asthma prevalence was highest among African Americans. African Americans also had higher rates of utilization for office visits and hospitalizations compared to whites. ER use among African Americans was greater than four times the rate for whites. These results are in agreement with national trends (Centers for Disease Control and Prevention 1998). In contrast to national trends, prevalence and utilization of health care services in this study were slightly higher in males compared to females.

Table 3 shows the asthma-related and total health care costs incurred by this population during the study year. Annual per recipient asthma-related and total health care expenditures were \$616 and \$3,564, respectively. Inpatient hospitalizations and medical services were the largest categories of

Table 2: Demographics and Utilization of Asthma-Related Health Care Services

<i>Demographic Group</i>	<i>Number of Patients</i>	<i>Rate per 1,000</i>	<i>Office Visits per 1,000</i>	<i>ER Visits per 10,000</i>	<i>Hospitalizations per 10,000</i>
Age					
≤16	15,659	65.2	98.1	103.2	89.6
16–45	6,109	40.0	65.0	83.6	34.4
>45	2,597	18.9	30.6	20.9	8.3
Gender					
Female	13,332	42.6	67.1	70.0	43.0
Male	11,033	51.0	77.2	85.4	66.7
Race					
White	19,609	45.4	70.8	53.0	48.6
African American	3,509	58.6	78.4	238.9	74.3
Unknown	1,149	43.0	84.7	110.3	85.9
Total	24,365	46.0	71.1	76.3	52.6

Note: Rates are expressed per total Medicaid population ($n = 530,000$).

asthma-related costs. Although this population included all patients with a primary diagnosis of asthma, direct asthma-related expenditures were only a small portion (17 percent) of total health care costs. The largest percentage of total health care expenditures was not spent on inpatient, outpatient, or emergency room care but on “other” care, such as nursing home care, durable medical equipment, and community mental health centers.

Of the patients identified as having asthma, 36 percent received a prescription for an inhaled short-acting beta₂ agonist. Medications used most often by patients who did not receive inhaled short-acting beta₂ agonists were other dosage forms of short-acting beta₂ agonists (tablet, syrup, nebulizer solution), mast-cell stabilizers, and oral steroids (data not shown). Referring to Table 1, the majority of patients who received inhaled short-acting beta₂ agonists did not use them on a daily basis. Of the patients who used inhaled short-acting beta₂ agonists on a daily basis, less than 10 percent received inhaled steroids on a continuous basis. These data suggest that the majority of patients were not receiving medication regimes consistent with the guidelines.

The relationships between independent predictor variables and asthma-related ER visits and hospitalizations are shown in Table 4. Overall, the results indicate that daily use of an inhaled short-acting beta₂ agonist was associated

Table 3: Asthma-Related and Total Health Care Costs by Type of Service

<i>Type of Service</i>	<i>Average Cost per Service (\$)</i>	<i>Total Costs (\$)</i>	<i>Percent of Disease-Related Costs</i>
Asthma related			
Emergency room	244.34	948,049	6.3
Inpatient	2,074.08	5,792,914	38.6
Outpatient	211.43	754,605	5.0
Medical services	71.17	3,478,832	23.2
Other	494.25	955,386	6.4
Pharmaceuticals	31.26	3,081,940	20.53
<i>Subtotal</i>		15,011,726	17.29†
Nonasthma related			
Emergency room	183.31	2,904,747	4.0
Inpatient	2,690.32	13,142,228	18.3
Outpatient	205.63	8,739,734	12.2
Medical services	80.27	14,896,392	20.7
Other	707.25	21,689,368	30.2
Pharmaceuticals	30.02	10,464,277	14.6
<i>Subtotal</i>		71,836,746	82.72†
Total		86,848,472	100

†Percentage of total cost for the population.

[odds ratio (OR) = 1.5, $p < .05$] with an asthma-related hospitalization when compared to the control group. Thus, daily use of inhaled short-acting beta-2 agonists in the absence of inhaled steroids or nonadherence with the guidelines increases the risk of hospitalization.

African American race (OR = 1.6, $p < .05$) and prescriptions for oral steroids (OR = 1.3, $p < .05$) were also associated with an asthma-related hospitalization. No significant differences in asthma-related hospitalizations existed between the control and inhaled steroid user groups.

No association was found between daily use of inhaled short-acting beta-2 agonists and ER visits. Consistent with previous studies (Wissow, Gittelsohn, Szklo, et al. 1988; Gerstman, Bosco, and Tomita 1993; Bosco, Gerstman, and Tomita 1993; Gottlieb, Beiser, and O'Connor 1995; Joseph, Havstad, Ownby, et al. 1998), the sociodemographic control variables urban residence (OR = 2.0, $p < .05$) and African American race (OR = 2.6, $p < .05$) were significant and positively correlated with ER visits. A weak association between ER visits and prescriptions for oral steroids (OR = 1.2, $p < .05$) was seen.

Table 4: Predictors of Asthma-Related ER Visit and Hospitalization

Variable	Emergency Room Visit			Hospitalization		
	Beta Coefficient	Chi Square	Odds Ratio	Beta Coefficient	Chi Square	Odds Ratio
Age (number of years)	-0.003	1.309	0.997	-0.031	76.663*	0.969
Gender						
Female			1.000			1.000
Male	-0.047	0.430	0.954	-0.169	3.413	0.845
Race						
White			1.000			1.000
African American	0.958	148.689*	2.607	0.462	16.892*	1.587
Other	0.347	0.742	1.414	-0.219	0.123	0.803
Residence						
Rural			1.000			1.000
Urban†	0.704	104.167*	2.021	-0.037	0.152	0.964
Number of other short-acting beta- ₂ agonists	0.016	1.705	1.016	0.037	6.826*	1.038
Number of long-acting beta- ₂ agonists	0.013	0.508	1.014	0.038	3.018	1.039
Number of oral steroids	0.172	103.321*	1.187	0.249	161.521*	1.283
Number of xanthines	0.003	0.065	1.003	0.041	7.508*	1.042
Number of ipratropiums	-0.001	0.001	0.999	-0.012	0.207	0.988
Number of mast-cell stabilizers	0.022	1.253	1.022	0.002	0.009	1.002
Number of other drugs	-0.003	4.142*	0.997	-0.004	2.703	0.997
Patient group						
Control patients			1.000			1.000
Daily beta-agonist users	0.100	1.988	1.106	0.389	18.855*	1.475
Inhaled steroid users	-0.282	1.975	0.754	0.149	0.399	.161
Intercept	-2.350	816.434*		-2.177	476.509*	

* $p < .05$.

†Individuals residing in counties belonging to a metropolitan statistical area (Population Estimates Program 1997).

DISCUSSION

This study used an integrated pharmacy, provider, and institutional claims database to determine the prevalence of, utilization of health care services for, and cost of asthma in a state Medicaid population. The prevalence of asthma in this population was similar to national estimates and rates reported for commercial and Medicaid populations enrolled in HMOs (Centers for Disease Control and Prevention 1998; Nestor et al. 1998; Stempel et al. 1996). In agreement with previous studies we found increased asthma prevalence

and rates of utilization of health care services in African Americans and urban residents (Centers for Disease Control and Prevention 1998; Wissow, Gittelsohn, Szklo, et al. 1988; Gerstman, Bosco, and Tomita 1993; Bosco, Gerstman, and Tomita 1993; Gottlieb, Beiser, and O'Connor 1995; Joseph, Havstad, Ownby, et al. 1998).

To our knowledge this is the first study that reported both the asthma-related and total health care costs of asthmatic patients in a Medicaid population. Previous studies that estimated the cost of asthma were either from a national perspective and included indirect costs (Weiss, Gergen, and Hodgson 1992; Smith, Malone, Lawson, et al. 1997) or analyzed direct costs from the perspective of commercial HMOs (Stempel et al. 1996; Langley 1999). While the average annual per-recipient asthma cost that we report is consistent with prior estimates (Stempel et al. 1996; Langley 1999), accurately comparing costs between Medicaid patients and other populations is difficult because of inherent differences in the populations and different reimbursement rates paid to providers.

Less speculative comparisons can be made between the proportion of total costs that are attributable to asthma and the proportion of asthma-related costs spent in various cost centers. Our finding that only 17 percent of total health care costs were due to asthma is much lower than previous reports (29 percent) (Langley 1999). Low asthma costs in relation to high total health care expenditures suggests that, in general, Medicaid patients are a sicker population and have other comorbidities that account for a significant amount of their total health care costs. Unfortunately database limitations prevented us from examining comorbidities.

The implications of these findings are that disease management programs or other interventions aimed at controlling costs and improving quality of care must be comprehensive in nature, taking into account the significant amount of comorbidities in this population. Interventions focused solely on asthma management will likely not have a substantial impact on total health care expenditures.

Previous researchers found that the majority of asthma-related costs were spent on inpatient care and pharmaceuticals (Weiss, Gergen, and Hodgson 1992; Smith, Malone, Lawson, et al. 1997; Stempel et al. 1996). In contrast, we found the highest proportion of asthma-related costs were spent in the inpatient (38.6 percent) and medical services (23.2 percent) cost centers. In this Medicaid population pharmaceuticals were readily available without cost-sharing provisions or restraints on the number of prescriptions one could

receive in a month. Therefore, we would have expected pharmaceuticals to represent a greater proportion of asthma-related costs in this population compared to the general population or populations enrolled in commercial HMOs, which are subject to cost sharing in the form of coinsurance, co-payments, and deductibles. Perhaps greater spending on pharmaceuticals as part of an asthma management program would result in increased control of asthma symptoms and decreased utilization of inpatient and medical services.

Although the guidelines suggest that all asthmatics should have access to a rescue medication, fewer than 40 percent of the Medicaid patients received an inhaled short-acting beta-₂ agonist during the study year. While this is a relatively small percentage, children less than six years of age were a large proportion of the population. Perhaps these children were unable to use a metered-dose inhaler accurately and were prescribed other dosage forms of short-acting beta-₂ agonists such as syrup, tablets, or nebulized solution.

The majority of patients who received inhaled short-acting beta-₂ agonists did not use them on a daily basis; however, of those who did, less than 10 percent received inhaled steroids on a continuous basis. This apparent lack of adherence with the guidelines has been reported elsewhere (McNally, Kreyenbuhl, and Zuckerman 1998). While the explanation for why patients are not receiving adequate therapy is not known, McNally suggests that either the guidelines have not been adequately disseminated, physicians have not embraced them, or barriers exist to their implementation by both patients and their health care providers. To increase awareness of the guidelines among practitioners, the Medicaid department in Kentucky sponsored a series of continuing education programs that focused on proper asthma management according to the guidelines. This analysis can serve as a reference point in evaluating the impact the continuing education programs have on increasing compliance with the guidelines.

Using a regression analysis that controlled for the known confounders urban residence and race, our findings are in agreement with those of previous studies (Donahue, Weiss, Livingston, et al. 1997; Nestor et al. 1998; Stempel, Durcanin-Robbins, Hedblom, et al. 1996), which found that nonadherence with the guidelines is associated with increased hospitalization rates. Although it was not a statistically significant finding, adherence with the guidelines or continuous use of inhaled corticosteroids was associated with decreased utilization of health care services.

Our inability to find a statistically significant relationship between inhaled steroid use and decreased ER and hospital care could be due to

limitations of cross-sectional analyses. With this type of analysis, it is uncertain whether the use of inhaled steroids occurred before or after the ER visit or hospitalization. A retrospective cohort design would allow one to determine more definitively if an association exists between inhaled steroid use and decreased ER care or hospitalizations. Previous researchers reported finding this relationship (Donahue, Weiss, Livingston, et al. 1997; Laumann and Bjornson 1998).

For this study we did not have patient enrollment files. By not having access to patient enrollment data we were unable to determine which patients were continuously eligible for benefits throughout the year. This precluded us from performing a retrospective cohort analysis.

Using claims data for research purposes has other disadvantages as well (Carson, Strom, and Morse 1989; Ray and Griffin 1989; Wingert et al. 1995/96; Armstrong and Manuchehri 1997; Lewis, Patwell, and Briesacher 1993; Motheral and Fairman 1997). Claims data are often only proxy measures of important concepts. For example, in this study, prevalence was determined by analyzing health care utilization data. Not all patients suffering symptoms will seek treatment. As a consequence they may not have a relevant identifying claim in the data. Thus, their contribution to prevalence estimates will be missed when prevalence is calculated based on utilization data. This would tend to underestimate the prevalence reported in this population. On the other hand, we considered claims as asthma related if they contained a primary or secondary diagnosis code for asthma. This may have overestimated asthma costs.

By analyzing utilization data to determine adherence with the medication component of the guidelines we are actually measuring prescribing patterns. There is no evidence that patients who were prescribed the medications took them correctly or were compliant in getting the prescriptions refilled. In our analyses we assumed that medications were used as prescribed. This would tend to underestimate the impact of adherence with the guidelines because medications are not always taken as prescribed (although patients not receiving proper prescriptions are unlikely to be adherent).

Likewise, using claims data alone, we were unable to control for asthma severity among patients in our study. Consequently, our analyses of the consequences of non-adherence to the guidelines (Table 4) may understate the prophylactic effects of proper asthma treatments, particularly for decreasing ER visits.

Finally, the costs recorded in Medicaid claims data are the reimbursements the government makes to providers, which are often less than the total

cost of the services. While reimbursements accurately gauge Medicaid costs from the government's perspective, they likely understate the services' total costs or costs to other third-party payers.

The advantages of using claims data outweigh the previously described disadvantages. Claims data cover virtually all treatments over a specified time for a large number of patients, thus allowing studies both among cohorts and over time. This allows claims data to be used to investigate important medical and health policy topics among large populations that would otherwise be cost prohibitive. Claims data infer whether patients in a high-risk population are receiving treatments in accordance with expert guidelines, thus revealing whether the treatments' promise as demonstrated in clinical trials is being effectively realized in applied contexts. This information serves both government policymakers and medical practitioners because, as this study has shown, nonadherence with expert guidelines can harm patients' health, exacerbate costs, and further strain health care delivery systems.

CONCLUSION

The majority of asthmatic patients in this Medicaid population were not receiving therapy in accordance with guidelines from the National Asthma Education and Prevention Program. Less than 40 percent of the asthmatic patients received a prescription for a rescue medication. Patients who used inhaled short-acting beta-₂ agonists on a daily basis and did not receive maintenance inhaled steroids had an increased risk for hospitalization. Asthma prevalence, utilization of health care services, and costs in this Medicaid population were similar to estimates reported nationally and in commercial HMOs (Centers for Disease Control and Prevention 1998; Weiss, Gergen, and Hodgson 1992; Nestor et al. 1998; Smith, Malone, Lawson, et al. 1997; Stempel et al. 1996; Langley 1999). Medicaid patients with asthma had a substantial amount of comorbidities, which necessitates the need for comprehensive disease management interventions.

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